

# Ozone

## Background

Ozone, when found at ground level, can be harmful to human health and the environment. Its impacts on human health range from eye irritation to severe respiratory distress that can lead to chronic illness and premature death. Ozone can have a deleterious effect on the environment, particularly plant life, resulting in crop and forestry losses. In addition, ozone has the ability to break down the basic components of everyday products that we rely on for shelter, mobility and beautification. It produces cracks in rubber and destroys exterior paint on buildings, motor vehicles and boats. The effects of ozone result from it being a strong oxidant. Ozone is especially reactive with molecules containing double carbon bonds. Such molecules are abundant in rubber, the photosynthetic apparatus of green plants, and the membranes lining the lung's air passages.<sup>1</sup>

Unlike many other air pollutants, ozone found in the lower atmosphere is not emitted directly but forms from other chemicals in the air that react together on hot, sunny days. The primary ozone precursors are volatile organic compounds (VOCs) and nitrogen oxides ( $\text{NO}_x$ ).  $\text{NO}_x$  is primarily emitted by motor vehicles, power plants and other sources of combustion. VOCs are emitted from sources such as motor vehicles, industrial facilities, consumer and commercial products such as paints and coatings, and natural sources such as trees. VOCs emitted from trees are part of the ecological cycle and alone would not lead to harmful levels of ozone. However, these emissions, when added to many anthropogenic sources, have the potential to exacerbate the creation of ozone in some regions. Ozone and its precursors also can be carried into New Jersey from upwind areas. As a result, controlling ozone pollution requires a broad range of measures to reduce sources of precursors both in New Jersey and in upwind regions. Ozone control efforts have involved discussions with more than 37 states covering most of the eastern half of the country.

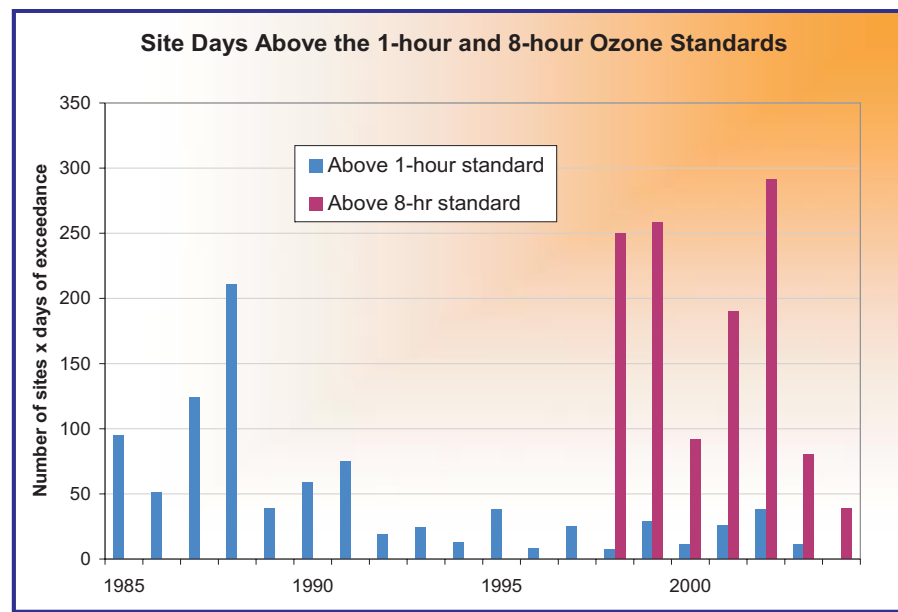
Ground-level ozone formation is mainly a daytime problem during the summer months because it is greatly increased by warm temperatures and abundant sunlight. Weather patterns have a significant effect on ozone formation and hot, dry summers will result in more ozone than cool, wet ones. In New Jersey, the ozone season runs from April 1 to October 31, although unhealthy conditions are rare before mid-May or after the first few weeks of September.

## Goals

National and state air quality standards have been established for ground-level ozone. The national health standard for ground level ozone was revised in 1997. It was changed from a maximum 1-hour concentration of 0.12 parts per million (ppm), the "one-hour standard" to a maximum 8-hour concentration of 0.08 ppm, the "eight-hour standard." Although several groups challenged the new standard, it was upheld by the U.S. Supreme Court in a February 2001 decision.

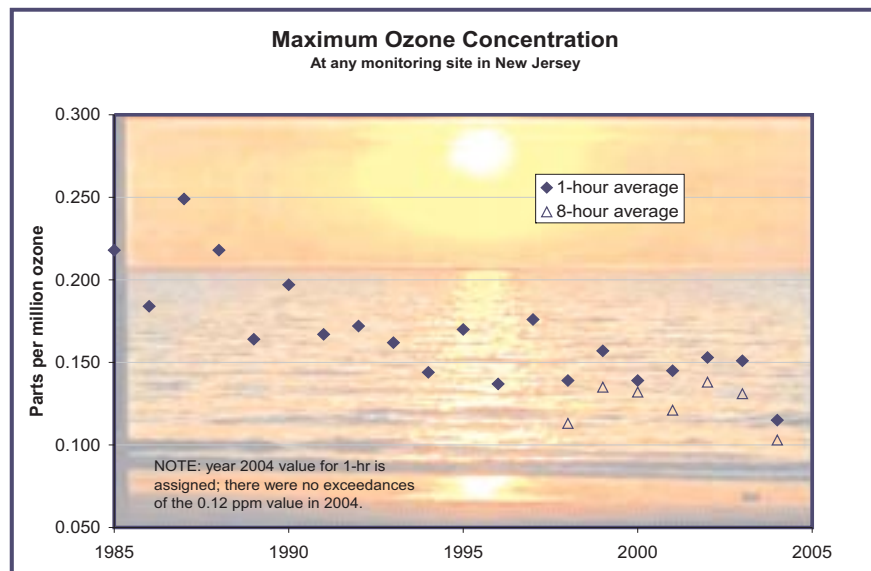
## Status and Trends

DEP regularly measures ozone concentrations at 15 sites in New Jersey. Days on which the ozone concentration exceeds the one-hour standard and the eight-hour standard, which are averages that determine whether an area meets Clean Air Act requirements, are recorded for each site. The total number of days the standards were exceeded at each site, and exceeded statewide, can be determined each year. (See "Site Days Above the 1-hour and 8-hour Ozone Standards" below).



There is a significant downward trend in the number of site days above the one-hour standard from the years 1990 (and earlier) to 2004. However, there is not a significant trend for the eight-hour standard.

The maximum ozone concentration recorded at any of the sites in each year also is recorded. These data show an extremely significant decline in recent years. (See “Maximum Ozone Concentration” below).



## Outlook and Implications

Trends in ground level ozone are influenced by many factors including weather conditions, economic activity, and changes brought about by regulatory control measures. Of these factors, weather probably has the most profound effect on year-to-year variations in ozone levels. Methods to compare ozone concentrations to weather are being explored. One simple approach looks at the number of days each year the temperature was above a certain threshold (e.g. 90 degrees F) compared to the number of days exceeding the ozone standard. Use of this approach supports the perception that high ozone concentrations are less common now than they were prior to around 1990.<sup>1</sup>

So far, however, using these approaches has not definitively answered the

question of whether or not ozone concentrations have stabilized in recent years. This question is important because the answer will determine whether existing control measures are leading to improvements or whether more stringent approaches will be necessary to bring New Jersey into consistent compliance with air-quality standards.

To date, reducing emissions of VOCs has been the primary means of lowering concentrations of ground-level ozone in New Jersey. Several important changes were instituted in 1988 and 1989, all of which were intended to reduce VOCs. These included reductions in the volatility of gasoline, the installation of Stage II vapor recovery<sup>2</sup> systems at gasoline stations, and the implementation of regulations to reduce the volatility of architectural coatings. Studies have shown that such an approach should lower peak ozone concentrations and it does appear to have been effective in achieving that goal.<sup>3</sup> Maximum one-hour concentrations have not exceeded 200 parts per billion (ppb) since 1988, and the last time levels above 180 ppb were recorded was in 1990. (See “Maximum Ozone Concentration” above.) But improvements may have leveled off in recent years, especially with respect to maximum eight-hour average concentrations. Significant further improvements will require reductions in both VOCs and NO<sub>x</sub>. The NO<sub>x</sub> reductions will have to be achieved over a very large region of the country because levels in New Jersey are dependent on emissions from upwind sources.<sup>4</sup>

## More Information

See the DEP Bureau of Air Monitoring Web site, [www.state.nj.us/dep/airmon/](http://www.state.nj.us/dep/airmon/), and the EPA Web site at [www.epa.gov/airnow/](http://www.epa.gov/airnow/).

## References

- <sup>1</sup> Spiro, Thomas, and William Stigliani, 2003, *Chemistry of the Environment*, 2<sup>nd</sup> Edition, Prentice Hall, Upper Saddle River, NJ 07458, page 226.
- <sup>2</sup> NJDEP, 2003, 2002 Air Quality Report, 2002 Ozone Summary, page 12, NJ Department of Environmental Protection, Bureau of Air Monitoring, Trenton, NJ, <http://www.state.nj.us/dep/airmon/02rpt.htm>, 12/23/04.
- <sup>3</sup> Stage II vapor recovery is the system used to control releases of gasoline vapors when motor vehicles are refueled. A specially designed fuel nozzle is used at the pump to collect vapors from a vehicle's gasoline tank that are expelled as fuel enters. The vapors are returned to the gasoline station's storage tanks.
- <sup>4</sup> NJDEP, 2003.
- <sup>5</sup> NJDEP, 2003